
**Unalloyed steel — Determination of low
carbon content —**

Part 1:

Infrared absorption method after combustion in
an electric resistance furnace (by peak
separation)

Acier non allié — Détermination des faibles teneurs en carbone —

*Partie 1: Méthode par absorption dans l'infrarouge après combustion dans
un four électrique à résistances (par séparation de pics)*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The main task of technical committees is to prepare International Standards. In exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 15349-1, which is a Technical Report of type 2, was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 1, *Methods of determination of chemical composition*.

This document is being issued in the Technical Report (type 2) series of publications (according to subclause G.3.2.2 of part 1 of the ISO/IEC Directives, 1995) as a "prospective standard for provisional application" in the field of determination of carbon content in steel because there is an urgent need for guidance on how standards in this field should be used to meet an identified need.

This document is not to be regarded as an "International Standard". It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of those documents should be sent to the ISO Central Secretariat.

A review of this Technical Report (type 2) will be carried out not later than three years after its publication with the options of: extension for another three years; conversion into an International Standard; or withdrawal.

ISO/TR 15349 consists of the following parts, under the general title *Unalloyed steel — Determination of low carbon content*:

- *Part 1: Infrared absorption method after combustion in an electric resistance furnace (by peak separation)*
- *Part 2: Infrared absorption method after combustion in an induction furnace (with preheating)*
- *Part 3: Infrared absorption method after combustion in an electric resistance furnace (with preheating)*

Annexes A to C of this part of ISO/TR 15349 are for information only.

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Unalloyed steel — Determination of low carbon content —

Part 1:

Infrared absorption method after combustion in an electric resistance furnace (by peak separation)

1 Scope

This part of ISO 15349 describes an infrared absorption method with peak separation procedure after combustion in an electric resistance furnace for the determination of the low carbon content in unalloyed steel.

The method is applicable to carbon contents between 0,000 3 % (*m/m*) and 0,010 % (*m/m*).

2 Normative references

The following standards contain provisions which, through references in this text, constitute provisions of this part of ISO 15349. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 15349 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1042:1998, *Laboratory glassware — One-mark volumetric flasks*.

ISO 3696:1987, *Water for analytical laboratory use — Specification and test methods*.

ISO 5725-1:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*.

ISO 5725-2:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*.

ISO 5725-3:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 3: Intermediate measures of the precision of a standard measurement method*.

ISO 14284:1996, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition*.

ISO 15349-2:—¹⁾, *Unalloyed steel — Determination of low carbon content — Part 2: Infrared absorption method after combustion in an induction furnace (with preheating)*.

3 Principle

Combustion of a test portion with accelerator at a high temperature in an electric resistance furnace in a current of pure oxygen. Transformation of carbon into carbon dioxide and/or carbon monoxide.

Measurement, by peak separation process, of infrared absorption of the carbon dioxide and carbon monoxide evolved from steel and carried by a current of pure oxygen.

¹⁾ To be published.

4 Reagents

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade and only grade 3 water as specified in ISO 3696.

4.1 Water, free from carbon dioxide.

Boil water for 30 min, cool to room temperature and bubble with oxygen (4.2) for 15 min. Prepare just before use.

4.2 Oxygen, 99,95 % (m/m) minimum.

An oxidation catalyst [copper(II)oxide or platinum] tube heated to a temperature above 450 °C must be used prior to a purifying unit, when the presence in the oxygen of organic contaminants is suspected.

4.3 Suitable solvent, appropriate for washing greasy or dirty test samples; e.g. acetone.

4.4 Accelerator, copper plate(see note 1) or granular tin (see note 2) of known very low carbon content less than 0,000 1 % (m/m).

NOTE 1 Copper plate (about 0,1 g/plate) should be used after the following treatment: heat the copper plate at 450 °C to 600 °C for 10 min in a current of oxygen and cool in a desiccator without grease. This treatment shall be carried out just before use.

NOTE 2 Granular tin should be used after the following treatment: rinse the granular tin in hydrochloric acid (ρ about 1,19 g/ml, diluted 1 + 1) for 5 min using an ultrasonic wave washer, wash it thoroughly with water and dry. Stock it in a clean glass bottle with ground-in stopper.

4.5 Standard substances

4.5.1 Sucrose, standard solution

Weigh, to the nearest 0,1 mg, the masses of sucrose, indicated in table 1, (analytical standard grade) previously dried at 100 °C to 105 °C for 2,5 h then cooled in a desiccator and transfer to seven 100 ml beakers.

Add 30 ml of water (4.1) to dissolve, transfer to seven 100 ml one-mark volumetric flasks quantitatively, dilute to the mark with water (4.1) and mix.

4.5.2 Calcium carbonate

Dry calcium carbonate [minimum assay 99,9 % (m/m)] at 180 °C for 1 h and cool in a desiccator before use.

4.6 Magnesium perchlorate [Mg(ClO₄)₂], particle size: from 0,7 mm to 1,2 mm.

4.7 Inert ceramic (attapulugus clay) impregnated with sodium hydroxide, particle size: from 0,7 mm to 1,2 mm.

Table 1 — Standard solution series of sucrose

Standard solution reference number	Mass of sucrose g	Corresponding mass of carbon added µg	Carbon content in 1 g of the test portion % (m/m)
1	0 1)	0	0
2	0,010 0	4,21	0,000 42
3	0,025 0	10,53	0,001 05
4	0,060 0	25,26	0,002 53
5	0,120 0	50,53	0,005 05
6	0,180 0	75,79	0,007 58
7	0,240 0	101,1	0,010 11
1) Zero member.			